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***Aureoboletus zangii* (Boletaceae), a new species from China**XIAO-FEI SHI<sup>1,2</sup> & PEI-GUI LIU<sup>1\*</sup><sup>1</sup> Key Laboratory of Biodiversity and Biogeography, Kunming Institute of Botany  
Chinese Academy of Sciences, Kunming 650201, Yunnan, China<sup>2</sup> University of Chinese Academy of Sciences, Beijing 100049, China\* CORRESPONDENCE TO: [pgliu@mail.kib.ac.cn](mailto:pgliu@mail.kib.ac.cn)

**ABSTRACT** — *Aureoboletus zangii* sp. nov. is described from central China based on morphological and molecular analysis. This species is found fruiting in association with hardwood trees. It is similar to the European *A. gentilis* and Asian *A. thibetanus* but is characterized by the yellowish brown or reddish golden basidiomata, glutinous pileus with subtomentum, and viscid stipe. LSU sequence analysis supports the new species in *Aureoboletus* (Boletaceae). Photographs, line drawings, and a phylogenetic tree showing relationships with closely allied taxa are provided.

**KEY WORDS** — Chinese fungal diversity, Boletales, taxonomy

**Introduction**

Two *Aureoboletus* species have previously been reported from China, *A. thibetanus* (Pat.) Hongo & Nagas. (Ying & Zang 1994) and *A. reticulocephus* M. Zang et al. (Zang et al. 1993), although the latter species has been transferred to *Boletus* (Wang & Yao 2005). Worldwide only 10 *Aureoboletus* species are recognized (Kirk et al. 2008). Although Pouzar named *Aureoboletus* with the type *A. gentilis* (Quél.) Pouzar in 1957 (Corner 1972, Kirk et al. 2008), the genus was not accepted for some time (Smith & Thiers 1971, Corner 1972, Singer 1986, Šutara 2005). After recent molecular analyses by Binder (1999) and Binder & Hibbett (2006) helped resolve the taxonomy of the genus, Klofac (2010) presented a world monograph in which he transferred 13 additional taxa to *Aureoboletus* and presented a species key (including some critical species in other genera). The morphological characters differentiating this genus from other bolete genera include: medium-small sized basidiomata, a pileus that is both viscid and subtomentose, yellow-colored tubes and pores, a hymenophoral surface more or less depressed around the stipe apex, a cylindrical to slightly swollen glutinous stipe that is never reticulate nor glandulose, and (most species) ectomycorrhizal with frondose trees (Klofac 2010).

## Materials & methods

Macroscopic and microscopic descriptions were based on fresh and dried material respectively. Color codes follow Kornerup & Wanscher (1961). For microscopical observations, slides were revived in 5% KOH solution and Melzer's reagent. The observation of the pileipellis structure was performed following Wang & Verbeken (2006). Micro-morphological features were examined under a Nikon E400 microscope at 1000× magnification and drawings were made through a drawing tube (Y-IDT) installed on the microscope. For further explanation of basidiospore data, see Yang (2000). All specimens examined were deposited in the Herbarium of Cryptogams, Kunming Institute of Botany, Chinese Academy of Sciences (KUN-HKAS).

Total DNA was extracted from silica-dried materials using a modified CTAB procedure by Doyle & Doyle (1987). The polymerase chain reaction (PCR) was performed using the primer pairs LROR/ LR5 to amplify the ribosome larger subunit (nrDNA-LSU) region of the nuclear ribosomal DNA (White et al. 1990). Sequencing of both strands was performed with an ABI 3730 DNA analyzer and an ABI BigDye 3.1 terminator cycle sequencing kit (Shanghai Sangon Biological Engineering Technology & Services CO., Ltd, Shanghai). The sequences have been submitted to GenBank (accession numbers JQ734420–734422).

## Taxonomy

*Aureoboletus zangii* X.F. Shi & P.G. Liu, sp. nov.

FIGS 1, 2

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Differs from *Aureoboletus gentilis* and *A. thibetanus* by its concolorous stipe and pileus and its shorter basidiospores.

TYPE: China, Shaanxi Province, Baoji City, Meixian County, Haoping Town, Dali Village, 34°05'N 107°42'E, alt. 1200 m, 4.IX.2010, X.F. Shi 654 (Holotype, HKAS63217; GenBank JQ734420).

ETYMOLOGY: *zangii* is in honor of Prof. Mu Zang (28 Dec. 1930–10 Nov. 2011), a distinguished Chinese mycologist who founded the Cryptogamic Herbarium at Kunming Institute of Botany, Academia Sinica (KUN-HKAS).

**MACROCHARACTERS** — **BASIDIOMATA** small to medium, scarcely fleshy. **PILEUS** at first hemispherical then expand to convex, 3–4 cm in diam; surface glutinous when fresh, grayish orange to yellowish brown or reddish golden to light brown (6B3, 5D5–5E5, 6C4–6D5); with concolorous subtomentum, without sterile margin. **STIPE** 5.5–7 × 0.5–0.8 cm, cylindrical or clavate, usually tapering towards the base, mostly concolorous with the pileus or more reddish, light brown to brownish orange (7C6, 6D5), sometimes darkening towards the base, violet-brown (11E8), sometimes changing to reddish-white (9A2) or violet-brown (10F7) when bruised, distinctly viscid especially in wet weather, entirely fistulose and showing white mycelium at the base. **CONTEXT** 0.2–0.3 cm thick, pale yellow or orange-white (2A3, 6A2), always more or less pinkish under the cuticle, unchanging when bruised or exposed to air. **TUBES** 0.3–0.5 cm deep, vivid yellow at first and then olive yellow, grayish yellow or vivid yellow (2C6,



FIG 1. *Aureoboletus zangii* (Holotype).

2B7, 2A8, 2A6), unchanging when exposed to air. PORES 1–2 per mm, bright yellow or concolorous with tubes, unchanging, depressed around the stipe. ODOR not distinctive. TASTE mild.

**MICROCHARACTERS** — **BASIDIOSPORES** [80/3/3] (10–)10.5–11.0 × (4.0–)4.5–5.0  $\mu\text{m}$ ,  $Q = (2.1\text{--})2.2\text{--}2.4\text{--}(2.5)$ ,  $Q_m = 2.23 \pm 0.09$ , elongate elliptical, yellowish-olivaceous in 5% KOH, thin-walled, sometimes with tiny oil drops; yellow to yellowish-brown in Melzer's. **BASIDIA** 30–38 × 11–14  $\mu\text{m}$ , clavate, with 4 sterigmata. **PLEUROCYSTIDIA** 35–65 × 11–18  $\mu\text{m}$ , narrowly clavate, yellow in 5% KOH and lacking any incrustations. **CHEILOCYSTIDIA** 35–42.5 × 11–17  $\mu\text{m}$ , similar to pleurocystidia. **CAULOCYSTIDIA** absent. **HYMENOPHORAL TRAMA** divergent, with hyphae 4–5  $\mu\text{m}$  in diameter, thin-walled. **PILEIPELLIS** a layer consisting of mostly inflated hyphae tending to repent under the gelatinous layer, slightly brownish in 5% KOH, 7–10  $\mu\text{m}$  in diameter.

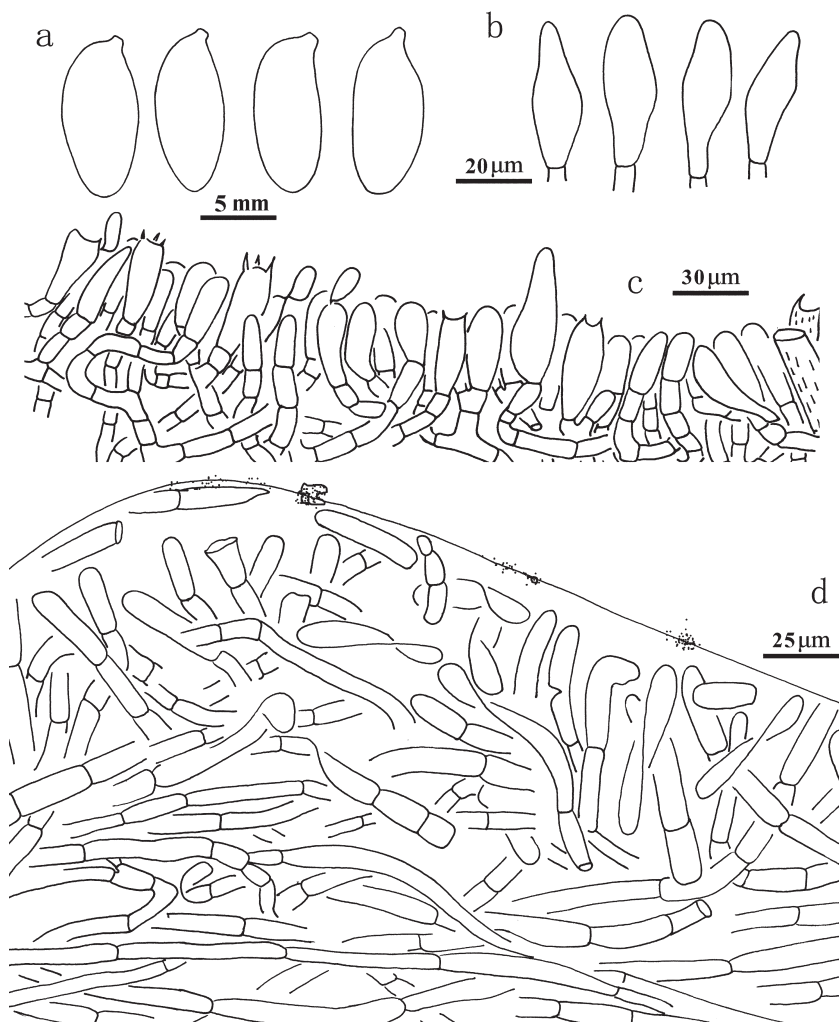


FIG 2. *Aureoboletus zangii* (Holotype). a. Basidiospores; b. Cystidia; c. Hymenium; d. Pileipellis.

**ECOLOGY & DISTRIBUTION** —Solitary, rarely gregarious, widespread in central China, on the ground, in subtropical broad-leaved mixed forests dominated by *Cyclobalanopsis* and *Quercus*, alt. 1200–1400 m.

**ADDITIONAL SPECIMENS EXAMINED** — **CHINA. GUIZHOU**, Daozhen: near Yangxi Town, 28°50'N 107°36'E, alt. 1200 m, 28.VII.2010, X.F. Shi 394 (HKAS 63220; GenBank JQ734422); Yangxi Town, Dashuhe Conservation Area, 28°50'N 107°36'E, alt. 1400 m, 27.VII.2010, X.F. Shi 388 (HKAS 63219; GenBank JQ734421).

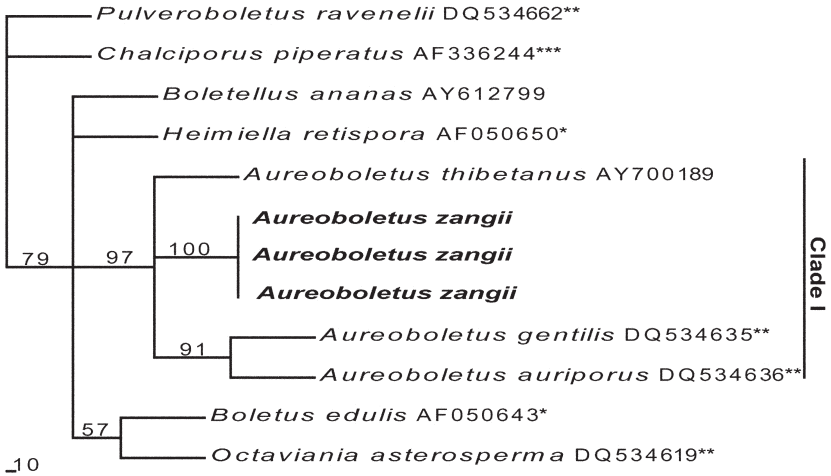


FIG 3. The MP tree from a phylogenetic analysis of LSU sequences of *Boletaceae*. Numbers above branches are bootstrap values (>50%). Sequences obtained in this study are presented in bold front; \* = sequences by Binder & Fischer (1997); \*\* = sequences by Binder (2006); \*\*\* = sequences by Wang et al.(2002); all other sequences were downloaded from Genbank.

## Phylogenetic results

Three samples were used for phylogenetic analysis. *Aureoboletus zangii* fell into the well-supported Clade I in FIG. 3. Phylogenetic analysis of nLSU supports *A. zangii* should be a member of the genus *Aureoboletus* along with the European species *A. gentilis* and the Asian species *A. thibetanus*.

## Discussion

The phylogeny confirms the new taxon as sister to *A. gentilis* and *A. thibetanus*. *Aureoboletus zangii* is similar to the European *A. gentilis* in its viscid reddish orange cap and viscid stipe, but the stipe of the new species is concolorous with its pileus, while in *A. gentilis* the stipe is bright yellow with just pinkish to brownish tinges in places. *Aureoboletus zangii* might also be confused with the Asian *A. thibetanus*, which can be distinguished by its reddish brown shrunken cap and yellowish white stipe. Anatomically, the *A. gentilis* spores are with largest ( $\leq 15 \mu\text{m}$  long) with those of *A. thibetanus* around  $12 \mu\text{m}$  long and those of *A. zangii* around  $10 \mu\text{m}$  long. In addition, the *A. zangii* cystidia are  $< 65 \mu\text{m}$  long while those of *A. gentilis* and *A. thibetanus* are  $\leq 70 \mu\text{m}$  long (Klofac 2010; Yang et al. 2003). Moreover, the outer surface of *A. thibetanus* is characteristically covered by a 5–8  $\mu\text{m}$  thick layer of a strongly refractive yellow substance that is quickly and completely dissolved in 5% KOH (Yang et al. 2003).

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